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The intersection of perception and mental verbs in development

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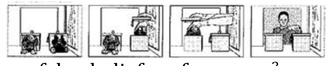
Introduction

Perception is linked to mental states both conceptually and linguistically.

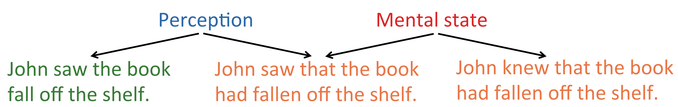
Conceptual links:



- Infants recognize that seeing leads to knowing[1,2]
- Training preschoolers on (mis)perception improves false-belief performance[3]

Linguistic links:

- Perception verbs and mental verbs share semantics and syntactic structures
- "Experience"[4] perception verbs like *see* can refer to both perception and mental representations resulting from perceptual experience



- Perception verbs with sentential complements express propositional content of mental states, just like mental verbs
- **Syntax shared by perception and mental verbs could play a role in children's acquisition of these verbs, specifically highlighting mental state reference for both types of verbs, consistent with syntactic bootstrapping[5,6]**

3 competing hypotheses for how syntax could help children learn mental state meanings of perception and mental verbs:

1) **Perception** Syntax **Mental**: Understanding of perception supports understanding of mental states (Gopnik et al.[3]); if so, then production of perception verbs with propositional syntax (i.e. sentential complements) would appear earlier and serve as a model for mental verbs.
2) **Mental** Syntax **Perception**: Mental verbs are produced with propositional syntax earlier, leading to understanding that perception verbs can refer to mental states.
3) **Perception** Syntax **Mental**: Acquisition of propositional syntax used to refer to mental representations is a single developmental achievement; if so, production of propositional syntax appears simultaneously for perception and mental verbs.

This study evaluated these hypotheses by examining children's production of perception and mental verbs in their syntactic frames.

Methods

Brown corpus[7] of CHILDES

- Adam (2;3 to 4;10), Eve (1;6 to 2;3;), Sarah (2;3 to 5;1), and their parents
- Target verb tokens:
  - Children: 5,727
  - Parents: 5,971
- Analysis: proportions of verb type (perception and mental) and frames produced by children and adults overall and by age; logistic mixed effects models[8] with verb type and age as fixed effects, subject as random effect

Target verbs[4,9,10,11,12]

Perception	Mental
see	*know*
hear	*think*
feel	*believe*
taste	*understand*
smell	*remember*
look	*forget*
listen	*guess*
watch	*pretend*
sound	*dream*
	mean

Syntactic frames used in coding

Frame	Perception verb examples*	Mental verb examples*
Non-embedded complements		
V	See?	I don't know.
V NP	I heard a motor boat.	I remember him.
V PP	Look in your bags.	I dreamed about Ursula too.
V Adj	He looks funny.	*[not attested]*
V NP VP	Watch me come back.	*[not attested]*
Embedded clause complements		
V CP	I see you carried the book with you.	He thinks the chair moves by itself.
V Q	See what I got in my hand?	I know what is missing.
V VP	*[not attested]*	I forgot to make a sailboat.

*Utterances produced by Adam

Results

Verb production overall

- Children produced more perception verbs than mental verbs, but their parents produced roughly equal numbers of both (Figure 1)
- Children's production of mental verbs, but not perception verbs, grew with age; their parents' production stayed stable over time (Figure 2)

Figure 1.

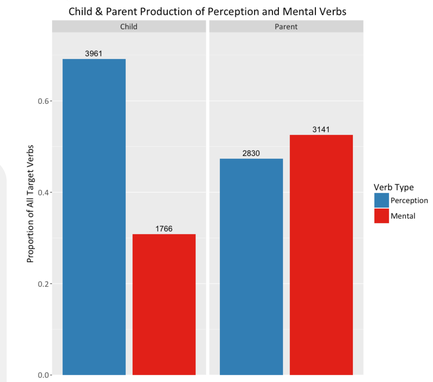
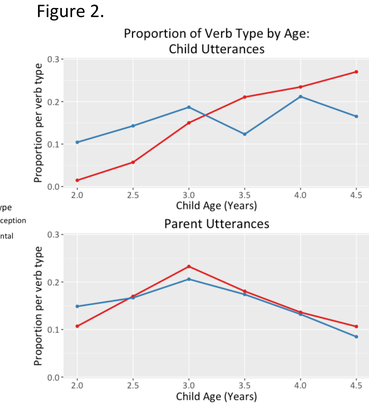


Figure 2.



Production of verbs in frames

- Children used embedded frames significantly more with mental verbs, and non-embedded frames significantly more with perception verbs ($\beta = 2.86$, SE = 0.26, $p < 0.001$) (Figure 3)
- Age also had a significant effect on children's use of embedded frames ($\beta = 1.02$, SE = 0.07, $p < 0.001$)
- Children overall used embedded frames significantly less often (25% of target verb uses) than their parents (36% of target verb uses) ($\beta = -1.33$, SE = 0.41, $p < 0.01$)
- Perception verbs with embedded frames were infrequent in both child and parent speech, but parents' proportion (9% of perception verb uses) was significantly more than children's (5% of perception verb uses) ($\beta = -0.74$, SE = 0.17, $p < 0.001$)

- Like children, parents used embedded frames significantly more with mental verbs and non-embedded frames significantly more with perception verbs, but child age had no effect on parents' use of frames ($\beta = 2.78$, SE = 0.07, $p < 0.001$) (Figure 4)

Figure 3.

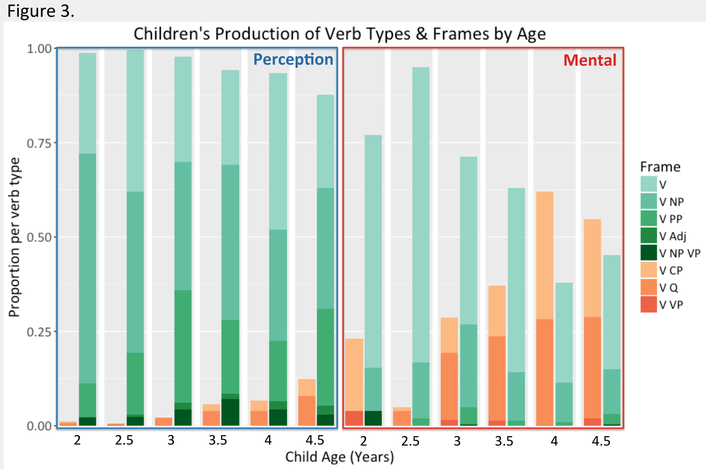
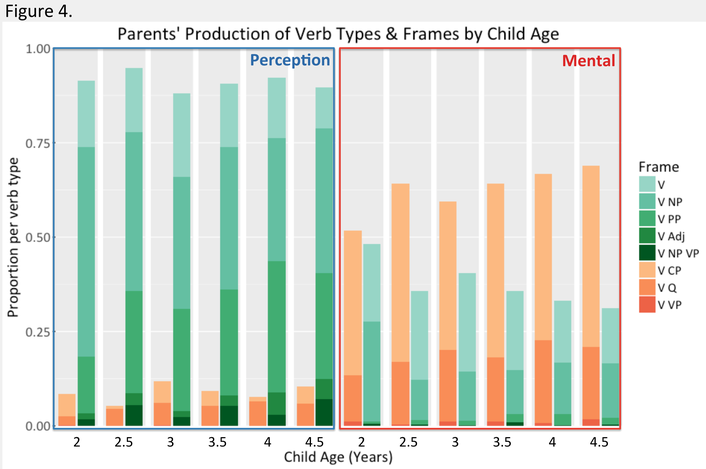


Figure 4.



Conclusions

✗ **Perception** Syntax **Mental**: Children produced sentential complements with perception verbs less than and no earlier than with mental verbs

✔ **Mental** Syntax **Perception**: Children used sentential complements with mental verbs more frequently than perception verbs, an effect that grows with age

✔ **Perception** Syntax **Mental**: Children's use of sentential complements appeared around the same time for both verb types

- **Support for 2 hypotheses suggests a more nuanced possibility:** acquisition of propositional syntax is a single achievement, but occurs after children have begun to produce perception verbs; learning this new syntax along with mental verbs requires them to revise their semantic representations for perception verbs to include mental reference.
- Empirical work needed to further test the hypotheses compatible with current findings; examining comprehension could reveal more about children's perception verb semantics and the role of syntax.

References

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